

**OFFSHORE SPAWNING OF THE STRIPED MULLET, *MUGIL CEPHALUS*, IN THE GULF OF MEXICO.**—The biology of the common or striped mullet, *Mugil cephalus* Linnaeus, has been the subject of numerous investigations, yet the locations of spawning grounds remain controversial. According to Higgins (1927, Rept. U. S. Comm. Fish., Bur. Fish. Doc. 1029: 624-627), Hildebrand and Schroeder (1927, Bull. U. S. Bur. Fish., 43(1): 192-196), Breder (1940, COPEIA (2): 138-139), Gunter (1945, Publ. Inst. Mar. Sci. Texas, 1(1): 51-52), and Taylor, *et al* (1951, Survey Mar. Fish. No. Carolina: 115) mullet spawn either inshore or within a few miles of the coast. Broadhead (1953, Fla. State Bd. Conserv., Tech. Ser. (7): 21) stated that indirect evidence, based on reports of commercial fishermen, indicates that spawning occurs in the Gulf, probably 5 to 20 miles offshore. Dekhnik (1953, Doklady Akademii Nauk, USSR; 93(1): 201-204) concluded that spawning of Black Sea mullet takes place chiefly near the coast, although some eggs of the species were found in plankton tows made far offshore.

For the past three years one of the projects of the Gulf Fishery Investigations has been a continuing study of the biology of East Lagoon, a narrow body of water slightly more than one mile long, in the northeastern end of Galveston Island, Texas. Waters of the lagoon are governed chiefly by tidal exchange via its opening into Bolivar Roads approximately three miles from the Gulf. Included in the information obtained during this study are pertinent observations on striped mullet. Large concentrations of roe mullet were observed frequently around the mouth of the lagoon from late October to mid-November. Although numerous schools of post-larval

*M. cephalus*, 25-30 mm. in total length, appeared regularly by mid-December, and often were taken in the nets, periodic plankton collections made in the area never have yielded fertilized eggs or early larvae. This suggests that spawning takes place beyond the range of tides and currents moving in and out of Bolivar Roads. In partial support of this suggestion, the dense schools of roe mullet disappeared suddenly from the vicinity of the lagoon and Galveston beaches for about 10 days in late November, 1956. Upon reappearing in scattered small schools, the fish were found to be spent. This occurrence agrees closely with the repeated observations of Florida commercial fishermen reported by Broadhead (*op. cit.*).

The presence of fertilized eggs and/or early larvae coupled with observations of suspected spawning activities should be undeniable proof that spawning has occurred. These conditions were met during a recent tuna long-lining cruise (December 3-13, 1956) of the U. S. Fish and Wildlife Service M/V OREGON in the north central Gulf of Mexico. The general area occupied was over the continental slope in depths from 500 to 900 fathoms, and 40-50 miles southeast of the Mississippi River Delta.

Shortly after midnight on December 11, the OREGON was drifting in 755 fathoms of water at approximately 28°20' N. Lat., 88°45' W. Long. While engaged in dip-netting over the side of the slowly drifting ship, we were surprised to see a compact school of approximately 200 striped mullet appear beneath our night-light. The fish were large adults and some were thought to be females because of their distended abdomens. Dip-net captures later proved this to be correct. We could not determine whether or

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not more than one school was involved, but mullet varying in number from about 50–250 circled the vessel every few minutes until just before dawn, swimming either at or within a few feet of the surface. As the sea was calm, we had a clear view of their activities.

From time to time as the schools came into sight, one or more groups of 3–6 fish would leave the school and swim around close to the surface in an erratic manner. Their subsequent behavior resembled that described by Breder (*op. cit.*); apparently spawning was taking place. As our field of visibility was limited to the illuminated area provided by the floodlight (about 30 feet out from and 50 feet along the side of the OREGON), a single group was seldom under observation for more than a minute. The actions described, therefore, are a composite of the behavior patterns of the 25 to 30 groups witnessed throughout the period of observation. In a typical group, the males, noticeably smaller and more slender, maintained positions slightly behind what was ostensibly a female. Five or six times while they remained in view, one or more of the males would quickly move up beside or below the female, nudging and pressing against her abdomen with head and body. Often during this action the individuals thus engaged would quiver and cease swimming momentarily, sometimes rising to the surface. The unoccupied males swam rapidly back and forth in the immediate vicinity until they in turn behaved in a similar fashion. We did not observe any of the "tight" formations of spawning groups described by Breder (*op. cit.*). There was little of the splashing and "milling around" that characterized the spawning activities of the closely related species, the silver mullet, as described by Anderson (1957, U. S. Fish and Wildlife Service, Fish. Bull. 119(57): 397–414). There was no evidence of milt or eggs in the water, but this could have been due to the drifting of the ship and the relatively small numbers of active spawners.

Seven fish were dip-netted from three of the spawning groups and identified as *Mugil cephalus*. Three were females with fork lengths of 285 mm., 290 mm., and 258 mm. The males measured 258 mm., 257 mm. (2), and 240 mm. Eggs could be extruded from the females with the slightest abdominal pressure and milt ran freely from the males.

In an attempt at fertilization, we placed milt and eggs from a captured male and female in an 8-quart plastic bucket containing sea water. The experiment was not successful. However, we later learned that Anderson (*op. cit.*) also failed

in fertilization attempts with silver mullet using an aquarium of several gallons capacity, but succeeded when he used small culture jars. The reason(s) for this difference in results is unknown.

A series of eight sub-surface plankton tows with a #1 monel mesh net was made during long-line operations. The net, with a 15-inch diameter opening, was towed at an average speed of 4 knots. On numerous occasions throughout this period we observed thousands of little silvery fish in the area, swimming near the surface in small, closely packed schools. The plankton samples, sorted at the Galveston laboratory, yielded over 2,000 of these, or strikingly similar fish, varying in total length from 4 mm. to 25 mm. The larger specimens (20 mm. and over) were identified as striped mullet by careful comparison with known post-larvae of the species previously taken in local collections. A developmental series down to 9 mm. in length, tentatively identified as *M. cephalus*, was obtained by working backwards through successively smaller sizes. For possible confirmation, 30 specimens of varying sizes were picked indiscriminately out of more than 2,000 in the plankton collection and forwarded to W. W. Anderson at the Brunswick laboratory. He identified 20 of these specimens as *Mugil* species, not *Mugil curema*. In qualifying his identification Anderson pointed out that the fantail mullet, *Mugil trichodon* Poey, also present in the Gulf, has the same anal fin-ray count as *M. cephalus*. As the very young of the fantail mullet never have been described, larval forms of the two species could have been confused. However, as fantail mullet occur in the northern Gulf only as occasional strays, and as spawning activities observed in the early morning hours of December 11 were unquestionably those of striped mullet, such a possibility is extremely remote.

Additional evidence that we had witnessed actual spawning of *M. cephalus* was the presence of several hundred fertilized eggs of the species in the plankton collection. The eggs, in early stages of development, were identified by comparing them, microscopically, with those stripped from the captured females.

While by no means excluding the possibility of inshore spawning, the foregoing observations and plankton collection results, including size range of the larvae and post larvae, should establish conclusively that spawning of striped mullet does occur offshore in relatively deep water and for a period of at least several weeks.

Other offshore observations of *Mugil cephalus* are of possible significance and are offered for consideration. No fish were captured, but the

observations were made by fisherman who had fished commercially for mullet for many years, and all were positive in their identification.

On November 27, 1950, the OREGON was at anchor off the Texas coast 30 miles southeast of the Aransas Pass jetties in 30 fathoms of water. Personnel aboard the vessel observed large striped mullet in schools of about 50-200 at various times from 0340 to 1252 hours. That afternoon, while the vessel was underway, similar schools were sighted on four occasions between 1336 and 1430 hours, from 27°30' N, 96°29' W to 27°23' N, 96°23' W. Depths ranged from 42 to 59 fathoms. Unfortunately, actions of the mullet were not noted.

William T. Cothrun, a commercial fisherman of Sabine Pass, Texas, reported, in a personal

interview, that he had encountered immense shoals of striped mullet in late November, 1950, some 65 miles south of Mobile, Alabama, in 20-25 fathoms of water. Mr. Cothrun was aboard the P-83, an oil company motor vessel. According to his account, the ship steamed through the shoals for several hours. The mullet were swimming slowly in an easterly direction, frequently with their heads out of water, at which times "smacking" noises were audible.

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